

The Hepp-Couinaud Approach to Strictures of the Bile Ducts

I. Injuries, Choledochal Cysts, and Pancreatitis

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Objective.

The results of operative repair of benign strictures of the bile duct after cholecystectomy, right hemihepatectomy, vagotomy and antrectomy, choledochal cysts in adults, and chronic pancreatitis, with particular reference to the use of the Hepp technique for hilar strictures and without the use of transanastomotic tubal stenting, were analyzed in 44 patients.

Summary Background Data.

End-to-side bilio-enteric anastomoses have been reported to be associated with restricting and reoperation in 12% to 25% of cases and operative morbidity and mortality rates of 10% and 5% to 8%, respectively. Long-term transanastomotic tubal stenting is widely practiced in an attempt to prevent or diminish anastomotic stricturing.

Methods.

The Hepp technique of wide, accurate, mucosa-to-mucosa anastomosis between the left hepatic duct and a jejunal Roux loop was used in 28 patients with hilar bile duct strictures. The same technical principle of wide side-to-side anastomosis was used in most of the lower strictures. Patients have been observed for 1 to 14 years (median, 7 years).

Results.

The operative mortality rate was 7% (3 patients), but only 2.4% (1 patient) in 41 noncirrhotic patients. Two patients who had undergone standard end-to-side hepaticojejunostomy required reoperation (Hepp procedures) for recurrent strictures. No recurrent strictures occurred with the use of the Hepp technique for hilar strictures or wide side-to-side anastomosis for lower strictures. None of these patients experienced episodes of ascending cholangitis.

Conclusions.

The Hepp approach provides a safe, durable, and highly effective solution to the problem of strictures of the bile duct, including hilar strictures. Transanastomotic tube stenting is not necessary.

Benign strictures of the bile ducts continue to enjoy a considerable notoriety. This is particularly the case with high strictures at or just below the confluence of the right and left hepatic ducts, and this notoriety is derived from the perceived technical difficulty of surgical repair of these strictures, reports from major tertiary referral centers of frequent restricturing, the need for one or more reoperations in 12% to 25% of patients,¹⁻⁶ and operative morbidity and mortality rates of 10% and 5 to 8%, respectively.⁷ There is a widely held conception that anastomoses involving the biliary tract are inherently particularly susceptible to stenosis. Accordingly, the practice of long-term transanastomotic tubal stenting is widely prevalent.¹⁻⁷

The results cited above refer to an end-to-side technique of anastomosis between the biliary tract, usually the stump of the common hepatic duct, and the intestine. Fifteen years ago, my attention was drawn by Professor Maurice Mercardier to the seminal papers in the French literature by Hepp and Couinaud⁸ and Soupault and Couinaud.⁹ It was immediately apparent that these approaches to the major left and right ductal systems and their confluence would permit the realization of the prerequisites of any visceral anastomosis (*i.e.*, a wide, water-tight, mucosa-to-mucosa apposition between healthy tissues). I have used these techniques almost exclusively for the past 15 years, and this report is a personal series of benign strictures resulting from operative injuries, choledochal cysts, and pancreatitis. The results of its application to patients with primary sclerosing cholangitis and malignant strictures of the bile ducts are reported in accompanying papers.

PATIENTS AND METHODS

Etiology

Forty-six procedures were performed in 44 patients (Table 1). The majority of strictures (26 in 25 patients) followed cholecystectomy, with smaller numbers after hepatic and gastric surgery. All of these patients were referred after primary surgery, and in many cases after attempts at operative repair elsewhere. The patients with choledochal cysts were all young adults or adolescents.

Operative Procedures

The 46 operative procedures are listed in Table 2. The Hepp approach was used in the majority (28 proce-

Table 1. ETIOLOGY OF BENIGN STRICTURES

Etiology	No. of Patients	No. of Procedures
Postcholecystectomy	25	26
Post-right hepatectomy	4	4
Choledochal cysts	4	5
Post-vagotomy/antrectomy	2	2
Mirizzi syndrome	1	1
Hemangiomas	1	1
	44	46

dures). The Soupault round ligament approach⁹ was necessary in only one patient. End-to-end anastomosis and endoscopic dilatation of strictures were used in two patients each. Exploration of the common bile duct in the patient with the Mirizzi syndrome revealed no residual stricture after removal of the gallbladder. In the patient with diffuse visceral hemangiomas causing multiple areas of narrowing of the bile duct, no correction was technically feasible.

Operative Technique

The technique for operative repair of hilar strictures used in this personal series since 1979 is conceptually that described by Hepp in his original article in 1956⁸ and similar in detail to his illustrated description in 1985.¹⁰ The dissection of the hilar plaque ("la plaque hilare") is fundamental to the approach to the left duct. Identification of the duct during dissection may become apparent by the appearance of a tell-tale drop of bile should a sinus tract be entered. Needle aspiration is valuable in other circumstances. The sinus opening or a small punctate incision into the positive aspiration site is then dilated progressively with the tip of a "mosquito" hemo-

Table 2. OPERATIVE PROCEDURES (n = 46)

Procedure	No.
Hepp	28
Hepaticojejunostomy	6
Choledochojejunostomy	4
End-to-end anastomosis	2
Soupault	1
Transduodenal sphincteroplasty	1
Exploration of CBD	1
Endoscopic dilatation	2
Laparotomy only	1

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Accepted for publication January 5, 1993.

stat followed by the insertion of Bakes dilators until the tip of a curved Desjardin forceps can be introduced. If a previous end-to-side hepaticojejunostomy has been performed, sharp dissection of the intestinal loop off the base quadrate lobe (segment IV) will usually reveal a small sinus opening. Alternatively, opening the intestinal loop close to the hilum will allow a visible or palpable identification of the stenosed anastomosis, which can then be manipulated in a similar manner.

Once the Desjardin forceps has been introduced, awareness of the horizontal course of the left main duct allows it to be introduced right up to the base of the round ligament insertion. Caudal and anterior traction on the angled Desjardin forceps enables direct incision of the left duct throughout its length under visual and palpable control. The left hepatic artery usually passes anterior to the left duct close to the base of the round ligament recess. This is readily identifiable by careful dissection and the artery can be mobilized and retracted to the left by a vascular loop, allowing incision of the entire length of the duct. The same maneuver with a Desjardin forms allows 1 to 2 cm of the right duct to be exposed and incised in a similar manner with little or no parenchymal dissection. This is particularly necessary in many patients with primary sclerosing cholangitis or predominantly left-sided Klatskin tumors (discussed in the accompanying papers) in whom wide decompression of the right lobe is essential.

These maneuvers create a wide (2.5 to 3 cm) opening in the left duct, the confluence, and the beginning of the right duct if necessary. A 60-cm Roux loop, with the end closed, is then brought up retrocolically and an equivalently sized opening is made on its antimesenteric border. Preplacement of sutures in the anterior lip of the duct opening and the posterior lips of both the duct and jejunal openings, followed by "railroading" of the jejunal loop up into the hilum, tying the posterior row of sutures and finally completion of the anterior row is essential to obtain an accurate watertight mucosa-to-mucosa anastomosis. Eight to 12 sutures are used for both the anterior and posterior rows. Monofilamentous 4/0 polydioxanone has been used almost exclusively, with posterior knots tied on the inside and anterior knots tied outside. The preplaced sutures are secured serially by hemostats to two simple hooks on the anesthetic screen before railroading. Mild collective traction on these sutures greatly facilitates the accurate placement of succeeding sutures. Transanastomotic tube stents were not used. A bilateral subcostal ("buckethandle") abdominal incision and upward and forward retraction of the costal margin by a Doyen's retractor secured by a sling over the top of the anesthetic screen affords excellent exposure.

The principle of a wide side-to-side anastomosis is also applied to anastomoses between the common hepatic or

Table 3. PROCEDURES IN 25 PATIENTS WITH POSTCHOLECYSTECTOMY STRICTURES

Procedure	No.
Hepp-Couinaud procedure	21
Hepaticojejunostomy	1
End-to-end anastomosis	2
Endoscopic balloon dilatation	1
Operative dilatation	1

common bile ducts and the jejunum or duodenum. For the lower anastomoses, a continuous, one layer polydioxanone suture is often possible, but the railroading technique is usually preferable for anastomoses to the common hepatic duct.

RESULTS

Postcholecystectomy Strictures

The 26 procedures performed in 25 patients are listed in Table 3. The majority of the strictures were high: 21 were Bismuth¹¹ grade 3, 1 was grade 4, 1 was grade 2, and only 3 were grade 1. Accordingly, the Hepp-Couinaud approach was used for 21 structures. In the grade 2 stricture, the Hepp approach was not used and an end-to-side hepaticojejunostomy was performed. In the three grade 1 strictures, two were complete but very short and underwent resection of the strictures back to unscarred mucosa-lined duct and wide oblique end-to-end anastomosis. In the third patient, the stenosis was incomplete and was treated by three sessions of endoscopic balloon dilatation. The single operative dilatation was performed in a patient with a stenosis of an end-to-side hepaticojejunostomy performed elsewhere.

Fourteen of the 25 (56%) patients had undergone attempts at repair before referral: end-to-side hepaticojejunostomy in 6 (on 2 occasions in one patient), mucosal graft hepaticojejunostomy with prolonged transhepatic stenting 3 times in 2 patients, end-to-end repair in 2 patients, and external tube drainage in 4 patients. In one of the latter patients, the confluence of the major ducts and the common hepatic duct had been excised, and after requested advice by telephone to the operating room in another institution, the patient was referred with transhepatic silastic tubes in the right and left hepatic ducts and two controlled external biliary fistulae.

The results obtained are given in Table 4. The median follow-up time is 7 years (range, 1.3 to 14.5 years). Serum bilirubin level is normal in all patients. The slightly raised serum alkaline phosphatase level in four patients

Table 4. RESULTS AFTER REPAIR OF POSTCHOLECYSTECTOMY STRICTURES (n = 26)

Follow-up	1.5–14 yr
Median	7 yr
Current serum bilirubin	Normal in all patients
Current serum alkaline phosphatase	Raised in 4 patients
Recurrent cholangitis	2 patients
Reoperation	1 patient (end-to-end hepaticojejunostomy)
Hospital death	2 patients Cerebral hemorrhage Variceal hemorrhage
Infective complications	4 patients

was associated with established hepatic fibrosis after antecedent hepaticojejunostomy (more than once in two patients) and prolonged transanastomotic tube stenting. However, these levels are lower than those at presentation and all are stable. Only two patients have experienced ascending cholangitis. In one patient, there was a transient episode in the early postoperative period. The other occurred in the single patient undergoing end-to-side hepaticojejunostomy. Restenosis was demonstrated 5 years later and a Hepp procedure was performed. This was the single reoperation in the series. The patient remains well, with normal serum bilirubin and alkaline phosphatase levels, and is free from cholangitis 7 years after the Hepp conversion. The patients with oblique end-to-end anastomoses and with dilatations of stenosis have also all done well.

Two patients died in the hospital. One patient suffered a massive cerebral hemorrhage from a ruptured aneurysm on day 5. The other patient, with established secondary biliary cirrhosis and portal hypertension, sustained a massive variceal hemorrhage and died in hepatic failure.

Four patients experienced infective complications. There were two minor wound infections, but *Pseudomonas* septicemia developed in a patient in whom the preoperative endoscopic retrograde cholangiopancreatography examination was complicated by ascending cholangitis. The final patient, with an infected preoperative biliary fistula, had an infected collection in the hepatic hilus that responded to percutaneous aspiration. There were no instances of external bile leakage.

Strictures After Right Hepatectomy

These patients may present formidable technical problems because the hypertrophy of the residual left lobe makes access to the left duct much more difficult. This is particularly the case when the hypertrophied left lobe is

also fibrotic or cirrhotic. Two of the four patients in this series have done very well, with normal liver biochemistry 6 months and 6 years after a Hepp approach. The first of these had had a right hepatectomy after trauma to the liver and a previous end-to-side hepaticojejunostomy performed elsewhere. The second patient had a stricture after right hemihepatectomy for metastases from colonic cancer. The remaining two patients had established secondary biliary cirrhosis of the residual lobe. In the first of these, a satisfactory repair by the Hepp approach was performed, a temporary bile duct leak occurred, and the patient remains jaundiced 6 years later. In the final patient, exposure of the left duct by the Hepp approach was impossible. A satisfactory anastomosis was achieved by the Soupault round ligament approach,⁹ but the patient experienced disseminated intravascular coagulopathy and died 24 hours postoperatively.

Choledochal Cysts

Four patients presented as adults with pain, jaundice, and episodes of ascending cholangitis. Three of them had had previous surgical procedures. The first patient had had a choledochocystoduodenostomy performed at the age of 2 years. He presented to me with deep jaundice in 1973 at the age of 21 years. An end-to-side hepaticojejunostomy was performed. He remained reasonably well, but had episodes of cholangitis approximately annually for the next 18 years. At operation in August 1991, a tightly stenosed anastomosis was taken down and a standard Hepp procedure was performed. He is well, anicteric, and free from cholangitis 1 year later. The second patient had had a previous choledochocystojejunostomy performed. The anastomosis was tightly stenosed and the "cyst" was lined by granulation tissue. This was excised and a Hepp procedure was performed. The patient is anicteric and free from cholangitis 3 years later. The third patient also had had a cystojejunostomy performed and presented with recalcitrant episodes of cholangitis. At operation, the anastomosis was widely patent but the cyst was filled with debris. Dilatation involved the right and left ducts to some extent (Todani type IV). The cyst was excised and a 3-cm end-to-side hepaticojejunostomy-en-Y was performed after frozen section confirmation of the presence of a normal biliary epithelial lining. Cholangitis has been relieved and liver biochemistry is normal 2 years later.

The final patient also had a Todani type IV malformation, but with massive dilatation of the right and left hepatic ducts as well. The cyst was excised and the right and left ducts extensively deroofed. A 10-cm side-to-side anastomosis was performed between a Roux loop and the deroofed right and left ducts. The patient is asymptomatic and anicteric 4 years postoperatively.

Chronic Pancreatitis

The indication for biliary drainage was persistent jaundice in all seven patients. One patient had undergone a Whipple operation 9 months previously. Jaundice was caused by stenosis of an end-to-side choledochojejunostomy. This was taken down and converted to a standard Hepp procedure. The patient is anicteric 5 years later. In an additional five patients, biliary drainage was achieved by a 4 to 5-cm side-to-side anastomosis between the bile duct and the duodenum (three patients) and jejunum (two patients). Three patients had concomitant longitudinal pancreaticojejunostomy performed. All are well and anicteric 1 to 3.5 years later. The final patient had the unusual pathology of a very localized pancreatic process in the lower part of the head of the pancreas, producing a cholangiographic appearance suggestive of an ampullary carcinoma, and stenosis of the junction of second and third parts of the duodenum. At operation, the inflammatory nature of the process was confirmed and the problem solved by a transduodenal sphincterotomy and duodenojejunostomy. The patient is well 1 year later.

Strictures After Vagotomy and Antrectomy

Both patients were referred with external biliary fistulae (T-tube in one patient) after vagotomy and antrectomy. The injuries were virtually identical: transection of the bile duct immediately below the entrance of the pancreatic duct. In both long side-to-side anastomoses, 4 to 5 cm in length, were established between the common bile duct/common hepatic duct and a Roux loop. In both part of the circumference of the pancreatic duct was incorporated in the anastomoses. A railroad technique permitted accurate mucosa-to-mucosa apposition, and both patients are well 10 months and 2 years later.

DISCUSSION

The results of this personal series over a 14-year period indicate that the Hepp-Couinaud approach provides a safe, durable, and effective solution to the problem of benign bile duct strictures. The major impact is on the high strictures where a 2.5- to 3.5-cm, accurate, mucosa-to-mucosa, side-to-side anastomosis can be effected between a jejunal Roux loop and healthy ductal tissue by preplacement of sutures and a railroading technique. In the patient with a Bismuth type IV stricture, after mobilization and approximation of the posterior half of the circumferences of the right and left ducts, a similar anastomosis could be done with longitudinal incisions in the partially joined ducts. The same principle of a wide side-

to-side anastomosis was applied in most of the lower strictures.

The durability of the approach is reflected in a follow-up time of 1.5 to 14 years (median, 7 years). Seventy-four per cent of the postcholecystectomy patients have been observed for more than 5 years and 87% for more than 3 years. No patient undergoing a Hepp procedure for a high stricture or a wide side-to-side anastomosis for a lower stricture has required re-intervention. The two reoperations followed end-to-side hepaticojejunostomy (postcholecystectomy and choledochal cyst). In both the reoperation was a Hepp procedure, with successful outcome. All patients, except one with a stricture after right hemihepatectomy and established secondary biliary cirrhosis in the residual left lobe, are clinically and biochemically anicteric. The only two instances of recurrent episodes of cholangitis followed end-to-side hepaticojejunostomy and were relieved by Hepp procedures. The four patients with raised serum alkaline phosphatase levels all had secondary fibrosis and/or cirrhosis.

Two of the three hospital deaths occurred in patients with biliary cirrhosis and portal hypertension. Death was due to variceal hemorrhage precipitating hepatic failure and not to intraoperative hemorrhage. The impact of cirrhosis on mortality has been noted by others.⁷ Two of the four infective complications were serious: *Pseudomonas* septicemia and an infected intra-abdominal fluid collection in one patient each. Both were associated with preoperative biliary sepsis. The only example of transient external biliary leakage occurred in a patient with a stricture after right hemihepatectomy. The difficulty in obtaining a watertight anastomosis in these circumstances has been mentioned above and by others.^{7,8}

There are relatively few reports of the use of the Hepp approach and with a substantial follow-up. Not surprisingly, the longest and most durable series comes from France. Bismuth¹¹ observed 120 patients for 10 to 20 years, with excellent results in 93%. Five late deaths occurred in patients with secondary biliary cirrhosis, and only three patients (2.5%) had recurrent stenosis requiring reoperation. Transanastomotic stents were not used.

Blumgart et al.¹² reported on 63 patients treated by stricture repair: 3 with low strictures treated by choledochoduodenostomy, 56 with high strictures treated by the Hepp approach, 2 by the methods of Longmire and Sandford,¹³ and 2 by the mucosal graft technique.⁶ Two patients required reoperation for anastomotic stenosis and 8 patients had bile leaks that closed spontaneously, one after drainage of a bile collection. The mean follow-up period was 3.3 years. Transanastomotic tubes were used in all patients for at least 1 month (median, 4 months) and in two patients U-tubes remain *in situ*. Six patients had recurrent episodic jaundice and fever, including the two with a Longmire-type anastomosis. One

of the six patients became symptom-free after removal of a long-term tube and intraductal stones lying above the tube. Fifty-seven patients (90%) had a satisfactory result and 53 have normal liver function.

Gastrini and Pappalardo¹⁴ also used transanastomotic drainage for periods of 16 days to 8 months in 58 of 63 patients, 34 of whom had a Hepp-type anastomosis and 29 who had an end-to-side hepaticojejunostomy. Strictures of the anastomoses occurred in 15.4% at intervals of 2 months to 3 years, but it is not stated following which types of anastomoses these stenoses developed. Two additional series reported excellent results after the Hepp procedure without the use of transanastomotic stents. Fernandez¹⁵ describes 39 patients observed from 1 to 10 years. There were no recurrences of stricture and no deaths. Saber and El-Manialawi¹⁶ reported recurrent strictures in 2 patients with end-to-end anastomosis and in 3 patients with end-to-side hepaticojejunostomy, but in 0 of the 14 patients after a Hepp repair performed as a first procedure. No stents were used for the Hepp repairs. Two patients had transient bile leaks, however, the follow-up period was only up to 4 years.

The need and rationale for stenting of biliary-intestinal anastomoses have been the subject of prolonged debate and have recently been reviewed.^{5,7} It has been proposed that prolonged transanastomotic stenting permits maturation and limits contraction of collagen and the intrinsic tendency of these anastomoses to undergo stricture formation. The duration of stenting advised has varied from at least 1 month¹² to a mean of 13.8 months.⁵ The possibility that prolonged stenting might be deleterious is suggested in a report where stenting for 1 to 3 months produced better results than stenting for more than 3 months. In their recent review, Blumgart and Thompson⁷ state that "three to six months is now generally considered to be the minimum period of splintage with the tube left for 12 months in more difficult cases." However, in major centers where stenting has been practiced extensively, doubts about the rationale and efficacy have been expressed,^{1,3} and Blumgart, who routinely stented Hepp anastomoses, has reported that he has "recently omitted tubes altogether in a series of 25 patients without noticeable problems."⁷

The recurrent stricture rates of 0% to 2.5% in the current and the three other series of Hepp anastomoses without stenting^{11,15,16} compare very favorably with rates of 12% to 25% reported after end-to-side hepaticojejunostomy and transanastomotic splintage, often for prolonged periods. Furthermore, in Bismuth's series¹¹ 70% of patients and in the current series 56% of patients had had one or more previous operations and attempts at repair before the Hepp procedures, circumstances widely reported to be associated with escalating rates of recurrence of strictures.^{4,5}

It is evident that excellent and durable results are obtained by the Hepp procedure without the use of transanastomotic splintage. Rather, it is the principles and meticulous details of the procedure, namely, construction of a wide and accurate leak-proof mucosa-to-mucosa anastomosis, that are responsible for the excellent results. These prerequisites are not regularly obtainable with end-to-side biliary intestinal anastomoses and transanastomotic splintage. The fact that in these strictures the Hepp approach regularly permits anastomosis to healthy, unscarred ductal tissue is also important. However, the results obtained with the Hepp procedure in primary sclerosing cholangitis, reported elsewhere suggest that this is not the only factor involved in the efficacy of the procedure.

References

1. Braasch JW, Bolton JS, Rossi RL. A technique of biliary tract reconstruction with complete follow-up in 44 cases. *Ann Surg* 1981; 194:635-641.
2. Tompkins RK, Pitt HA. Surgical management of benign lesions of the bile ducts. *Curr Probl Surg* 1982; 19:327-398.
3. Pellegrini CA, Thomas MJ, Way LW. Recurrent biliary stricture: patterns of recurrence and outcome of surgical therapy. *Am J Surg* 1984; 147:175-180.
4. Genest JF, Nanos E, Grundfest-Broniatowski S, et al. Benign biliary strictures: an analytic review (1970-1984). *Surgery* 1986; 99: 409-413.
5. Pitt HA, Kaufmann SL, Coleman J, et al. Benign postoperative biliary strictures: operate or dilate? *Ann Surg* 1989; 210:417-427.
6. Smith R. Injuries of the bile ducts. In Smith R, Sherlock S, eds. *Surgery of the Gall Bladder and Bile Ducts*. London: Butterworths, 1974; p 361.
7. Blumgart LH, Thompson JN. The management of benign strictures of the bile ducts. *Curr Probl Surg* 1987; 24:7-66.
8. Hepp J, Couinaud C. L'abord et l'utilisation de canal hepatic gauche dans les reparations de la voie biliaire principale. *Presse Med* 1956; 64:947-948.
9. Soupault R, Couinaud C. Sur un procédé nouveau de dérivation biliaire intra-hepatique: les cholangio-jéjunostomies gauche sans sacrifice hepatic. *Presse Med* 1957; 65:1157-1159.
10. Hepp J. Hepaticojejunostomy using the left biliary trunk for iatrogenic biliary lesions: the French connection. *World J Surg* 1985; 9: 507-511.
11. Bismuth H. Postoperative strictures of the bile duct. In Blumgart LH, ed. *The Biliary Tract*. Edinburgh: Churchill Livingstone, 1982; pp 209-218.
12. Blumgart LH, Kelly CJ, Benjamin IS. Benign bile duct stricture following cholecystectomy: critical factors in management. *Br J Surg* 1984; 71:836-843.
13. Longmire WP, Sandford MC. Intrahepatic cholangiojejunostomy with partial hepatectomy for biliary obstruction. *Surgery* 1948; 128:330-347.
14. Gastrini G, Pappalardo G. Iatrogenic strictures of the bile ducts: our experience with 66 cases. *World J Surg* 1981; 5:753-758.
15. Fernandez M. Treatment of benign strictures of the bile ducts. *World J Surg* 1980; 4:479-482.
16. Saber K, El-Manialawi M. Repair of bile duct injuries. *World J Surg* 1984; 8:82-89.